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TECHNOLOGY APPLICATIONS

12 March 1975
102000-33-L

Mapping Exposed Silicate Rock Types and Exposed Ferric and Ferrous Compounds from a Space Platform

Quarterly Report for Period 8 December 1974 - 8 March 1975

(E75-10251) MAPPING EXPOSED SILICATE ROCK TYPES AND EXPOSED FERRIC AND FERROUS COMPOUNDS FROM A SPACE PLATFORM Quarterly Report, 8 Dec. 1974 - 8 Mar. 1975 (Environmental Research Inst. of Michigan) G3/43

N75-22863

Unclas
00251

EREP Investigation 444M
NASA Contract NAS9-13317

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Mapping Exposed Silicate Rock Types and Exposed Ferric and Ferrous Compounds from a Space Platform

Quarterly Report for Period 8 December 1974 - 8 March 1975

The following serves as the eighth quarterly report for this contract which is entitled "Mapping Exposed Silicate Rock Types and Exposed Ferric and Ferrous Compounds From a Space Platform. The financial reports have been submitted monthly under separate cover.

PROGRESS

Work was begun on mapping the study area using SL-4 S-192 data. The data set was examined to determine its exact boundaries, and a new study area was selected within the available data.

Difficulty was encountered in reading the digital tapes of S-192 data. All attempts to utilize these tapes on ERIM equipment proved unsuccessful, terminating when the hardware encountered permanent read errors. Further efforts to recover the data were made using the University of Michigan Terminal System I.B.M. 370/168 computer, where a successful tape copy was accomplished. A subtape of just the test site and seven S.D.O.'s was written for economical processing. A digital filtering technique was applied to the data to aid in noise reduction. This filtering was used along each line to reduce overshoot characteristics inherent in the data collected by the X-5 detector array (P. Lambeck, Personal communication). The tapes were then reformatted to make them compatible with multispectral scanner processing software currently in use at ERIM.

Following this preprocessing, an analysis of the quality and usability of the data was begun. Through initial graymapping, it was found that SDO-4 was highly saturated, and is essentially useless for the purposes of this project. Histograms of the signal levels were made for each SDO, using a sampling pattern of every fifth line and every fourth point. SDO's 8, 10, 14, and 20 are shown to contain about 1% bad data points. These histograms will be used in future processing to help determine parameters for ratio development. Due to the poor quality of SDO-4, there are now essentially no visible channels remaining in the data set. This could lead to limitation in portions of this study. Further, some of the SDO's which remain are somewhat noisy, which could diminish their usefulness in the formation of ratio images.

Work has begun on photogeologic interpretation of the study area, with the production of a set of maps currently in progress using S-190B imagery.

TABLE 1

SDO'S RECEIVED AND USED

SDO RECEIVED	SKYLAB CHANNEL	WAVELENGTH	USED? (X-IF USED)
3	4	.54- .60	
4	4	.54- .60	Not usable
7	6	.65- .73	
8	6	.65- .73	X
9	7	.77- .89	
10	7	.77- .89	X
11	11	1.55-1.73	
12	11	1.55-1.73	X
13	12	2.10-2.34	
14	12	2.10-2.34	X
16	-	Thermal	X
19	8	.93-1.05	X
20	9	1.03-1.19	X
21	13	10.2-12.5	

PLANS

During a previous study period, linear discriminant analysis was used to separately rank the twelve SKYLAB channels and sixty-six ratios according to their ability to separate 211 laboratory spectra of natural materials into seventeen assigned classes (Vincent and Pillars, 1974; 102000-22-L). This procedure produces a theoretically proposed priority of channels for studies concerned with separating natural materials and doing general geologic mapping. Although these groups are not defined strictly on ferrous and ferric concentrations, at least some of the classifications are appropriate to separate as likely to contain similar concentrations of reduced and oxidized iron. However, classification into the seventeen classes is, in some ways, inappropriate for ferrous-ferric mapping; for instance, class seventeen groups all common iron oxides, within which we may like to distinguish mineralogy or concentration. Of the SKYLAB channels considered in the preliminary study, few of those named important are available in the data set to be processed. Ranked single channels and ratios are presented from Vincent and Pillars (1974) in tables 2 and 3, respectively. Channels which are available for use in this study are starred.

It had been planned to conduct a comparison of broad band visible, in ERTS configuration, with narrow band SKYLAB and color photography for evaluation of possible improvement in the red to green ratio which was shown to be successful recognizing some ferric oxide influence using ERTS data. Lack of visible data for SKYLAB will result in a necessity to substitute a theoretical comparison using S-192 response-weighted reflectances for direct comparison to actual data.

The present plan for continuation of SKYLAB S-192 data processing is to concentrate on spectral characteristics of iron compounds in the reflective infrared spectral region. Infrared ratios chosen to enhance the differences between materials showing dominantly ferrous absorption and those showing dominantly ferric absorption spectra are available in this region.

TRAVEL

None.

Respectfully submitted,

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TABLE 2

RANKING OF SKYLAB S-192 CHANNELS FOR PRODUCING AUTOMATIC RECOGNITION MAPS OF ROCK, MINERAL, AND SOIL CLASSES (BASED ON DISCRIMINANT ANALYSIS OF 211 LABORATORY SPECTRA)

RANK	CHANNEL	
	NUMBER	WAVELENGTH (μm)
1	12	2.10 - 2.34 *
2	8	0.93 - 1.05 *
3	2	0.45 - 0.50
4	11	1.55 - 1.73 *
5	5	0.60 - 0.65
6	4	0.54 - 0.60
7	7	0.77 - 0.89 *
8	9	1.03 - 1.19 *
9	10	1.15 - 1.28
10	6	0.65 - 0.73 *
11	3	0.50 - 0.55
12	1	0.42 - 0.45

(from Vincent, R.K., and Pillars, W.W., 1974)

TABLE 3

TWELVE BEST RATIOS FOR PRODUCING AUTOMATIC RECOGNITION MAPS OF ROCK, MINERAL, AND SOIL CLASSES FROM SKYLAB S-192 SCANNER DATA (BASED ON DISCRIMINANT ANALYSIS OF 211 LABORATORY SPECTRA)

RANK	RATIO
1	$R_{7,5} = \frac{L_7\ (0.77 - 0.89\ \mu m)}{L_5\ (0.60 - 0.65\ \mu m)}$
2	$R_{3,2} = \frac{L_3\ (0.50 - 0.55\ \mu m)}{L_2\ (0.45 - 0.50\ \mu m)}$
3	$R_{8,4} = \frac{L_8\ (0.93 - 1.05\ \mu m)}{L_4\ (0.54 - 0.60\ \mu m)}$
4	$R_{10,9} = \frac{L_{10}\ (1.15 - 1.28\ \mu m)}{L_9\ (1.03 - 1.19\ \mu m)}$
5 *	$R_{12,11} = \frac{L_{12}\ (2.10 - 2.34\ \mu m)}{L_{11}\ (1.55 - 1.73\ \mu m)}$
6	$R_{7,3} = \frac{L_7\ (0.77 - 0.89\ \mu m)}{L_3\ (0.50 - 0.55\ \mu m)}$
7	$R_{4,2} = \frac{L_4\ (0.54 - 0.60\ \mu m)}{L_2\ (0.45 - 0.50\ \mu m)}$
8	$R_{4,3} = \frac{L_4\ (0.54 - 0.60\ \mu m)}{L_3\ (0.50 - 0.55\ \mu m)}$
9	$R_{7,2} = \frac{L_7\ (0.77 - 0.89\ \mu m)}{L_2\ (0.45 - 0.50\ \mu m)}$
10	$R_{7,4} = \frac{L_7\ (0.77 - 0.89\ \mu m)}{L_4\ (0.54 - 0.60\ \mu m)}$
11	$R_{8,5} = \frac{L_8\ (0.93 - 1.05\ \mu m)}{L_5\ (0.50 - 0.55\ \mu m)}$
12 *	$R_{8,7} = \frac{L_8\ (0.93 - 1.05\ \mu m)}{L_7\ (0.77 - 0.89\ \mu m)}$

(from Vincent, R.K., and Pillars, W.W., 1974)

REFERENCES

Vincent, R. K. and W. W. Pillars, "Skylab S-192 Ratio Codes of Soil, Mineral, and Rock Spectra for Ratio Image Selection and Interpretation, Proceedings of the Ninth International Symposium on Remote Sensing of Environment, Environmental Research Institute of Michigan, Ann Arbor, April 1974.